

MAKING A LIFE IN THE LIFE SCIENCES AND THE ROLE OF MENTORING FOR FEMALE SCIENTISTS

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Evidence of sex differences in intellectual capabilities remains scant and, rather than revealing genetic origin, it is complicated by the influence of social circumstances. Some inequities persist, and although these have been decreasing in recent decades, therefore, it remains a major task for policy makers and educators to assist in setting up programs, including mentoring opportunities, that are directed at alleviating such inequities. This paper outlines some historical circumstances in science and suggests that mentoring has to be understood in a wide systemic framework. The freedom to think and act and follow research ideas through is intrinsically rewarding to society and to the individual. For female scientists, it is a freedom that has yet to be fully developed and mentoring is just one way in which such a process can be legitimized. The paper outlines how institutions can best do this, and how this might work in practice for the individual, and argues that science needs to have its own code of mentoring.

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The evidence for and against sex differences in intelligence, problem solving and a range of specific intellectual and artistic abilities has been presented and refuted for the best part of a century. On close inspection, evidence of the alleged biological basis of specific sex differences in abilities, be this expressed in behavioral measures or in measurements of the brain itself, to date, is neither convincing nor significant enough to make pronouncements on differences in overall abilities between the sexes, and to act upon them in ways that discriminate against women [1–3]. Even the evidence of sexual dimorphism in the brain, such as the different distribution

of white and gray matter in male and female brains, raises the important point that structural differences need not result in functional differences. Haier et al concluded from their neuroanatomical work on sex differences in general intelligence, "that there is no singular underlying neuroanatomical structure to general intelligence and that different types of brain designs may manifest equivalent intellectual performance" [4]. For biological reasons, therefore there is no single compelling reason why women should not have the freedom to aspire to the highest offices and to the most prestigious science careers. The barriers on the way have been erected by gender-specific traditions and they are only slowly coming down. In terms of mentoring, it is important to be aware that any assistance rendered to women is not seen in terms of models of deficiency or inferiority but to recognize fully that social barriers are powerful gatekeepers that may prevent entry or hamper the pursuit of certain careers.



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PREVIOUS DECADES

We need to remember that the current rise of women in the professions, academia and research institutes are relatively recent. Specifically, the 1970s were a time when women across many nations battled for rights, justice and recognition, against male establishments, invisibility, lack of choices in general, and treatment of women as an inferior version of humanity [5]. In many countries, change was implemented in services, policies, legislation and education. Indeed, there was change that encompassed society as a whole [5]. Rosalyn Yalow, Nobel Prize Winner for Physiology or Medicine in 1977, well echoed the sentiments of her time when she said in her acceptance speech [6]:

Women are represented in reasonable proportion to their numbers in the community; yet among the scientists, scholars and leaders of our world they are not. No objective testing has revealed such substantial differences in talent as to account for this discrepancy (....) We cannot expect in the immediate future that all women who seek it will achieve full equality of opportunity. But if women are to start moving towards that goal, we must believe in ourselves or no one else will believe in us; we must match our aspirations with the competence, courage and determination to succeed; and we must feel a personal responsibility to ease the path for those who come afterwards. The world cannot afford the loss of talents of half its people if we are to solve the many problems, which beset us.

By the 1990s, this spirit of optimism that led to the belief that success for women was “just around the corner” had gone, and the time had come for more detached reflection and evaluation of the status of women, including their place in higher education and in research [7]. At the time, most of the western world believed that women could “make the grade” if only they knew how. The idea was to get women into careers so that their working options would eventually carry them out of lowly paid, non-career jobs. Often built on a deficit model (e.g. women need to learn much more to be on a par with men), a decade of teaching women in management and social skills books followed. The politics of optimism spawned a glut of “how to win” books [8–10] and informed women of the handful of outstanding women with successful careers [11], so as to provide role models for future success. The discourse also contained egalitarian

messages, which resulted in affirmative action strategies and promised to make the workplace a more equal, if not gender-neutral environment [12].

In some sectors, such as in education and the public service, the many strategies, policy changes and monitoring exercises seem to have borne some fruit. Retention rates of girls at high school have gradually increased and more young women seek post-school and tertiary qualifications. There is plenty of evidence that women have achieved top grades in higher school certificates and at universities, and have been very visible in merit awards. University medals, especially in science, often go to women. These are obvious successes that women have been able to demonstrate. Data on research grant and fellowship applications show, for instance, that women do as well as men, at least in Australia, according to the annual statistical reports of the Australian Research Council of Australia. Purely on merit and competitiveness, women are not just as capable and as active as men in the academy but they often excel in performance. So successful have women been in tertiary training that, by 1995, some academics claimed that women had been unduly favored and any affirmative action had to stop. Apparently, women were “storming” the professions to the detriment of men [13].

However, the reality is somewhat different and on several levels, be this at the level of structural and indirect discrimination, on a personal level, or in the way women’s lives may continue to be disadvantaged by the jobs they do and by what is expected of them [14]. A long list of publications from the 1980s shows the concurrent absence of a shift in expectations of women in their private lives for many have doubled the workday and the burdens of responsibilities in private and public life. It has been shown that women do not handle time badly but that they have multiple commitments and often conflicting time schedules and demands placed on them [15–19].

Although women appear to have adapted to the many sociopolitical changes in public institutions and corporations, especially economic rationalism, such adaptation may bear the seeds of its own destruction. Advice on how to get women to the top has tended to be couched in a language akin to Machiavellian scheming. At the very least, such advice often flags self-interest. Apart from the recognized importance of mentoring, there is little evidence in the literature on management that collaboration, mutual support and

strengthened networks among women have been systematically studied, let alone compared with support systems that have traditionally been the exclusive social domain of males, expressed in after-hours drinks and club activities, in direct or indirect mentorship, and in collaborative endeavors.

The prognosis that women would slowly make headway into leadership positions in the private sector has been revised in western countries to the admission that women's participation in universities continues to be rather uneven across different fields and at different steps of career ladders. Although women now often represent half of the student body (or more), their presence still tends to fall largely into traditional vocational areas such as service, teaching, and caring. Too many women within the university sector are still grouped at the bottom end of the scale and are proportionately underrepresented, and that tends to be more evident and the attrition rate higher, the higher the career position (see other contributions in this volume). Women remain more vulnerable, partly because they are disproportionately in junior positions and partly because their networking capacity and supporting skills are far more fragile than those of men in institutions. I will come back to this later.

PRE-CONDITIONS FOR SUCCESS

The question has to be asked anew today: what do we need to do today to be effective tomorrow? How can we ensure that women will be in worthwhile career positions and how can this continue to be shaped in science?

The female attrition rate is proportionally higher than that of males and increases in higher positions, therefore, it is clear that there are barriers to overcome—be this in the individual, the system, or both. From the point of view of the individual, self-esteem and self-confidence seem to play a major role. It is worth noting that a large population study of the late 1990s by Kling et al in the United States [20] showed a consistent difference in self-esteem between male and female students; they were 0.21 standard deviations apart. Unfortunately, this study has not been repeated more recently. Both showed normal distributions but self-esteem of girls and women was consistently (0.21 Effect Size) lower than that of their male counterparts (matched for age). Interestingly, in those studies that

claim that women have lower intelligence and are grouped more around the mean (see Rogers' critique in this volume), it is worth remembering that Kling's results show a difference in male and female responses, based on psychological differences and social responses to the world; findings which alone (without resorting to genetic bases of behavior) could well explain performance differences.

Self-confidence translates into the freedom to choose and assert oneself. It is probable that a perceived sense of freedom begins in early home life and in early school experiences. How much freedom of expression is given to a child, how much worth is attributed to the opinions of the child, and how much support the child receives for what he/she wants to do (and whether more daring work choices are even put before the child as options) are all important general criteria for a perception of self-confidence and future leadership. Any studies of infants confirm that the mind is highly susceptible to cultural, social and linguistic cues from very early in life, and these cues are often absorbed at a subconscious level.

In societies with traditional gender role practices, the supportive and nurturing role of teachers at any level of the education process can be crucial. It is not uncommon for women of high international profile to say that they had at least one person during their childhood who thought that what they did was wonderful. Bella Abzug, lawyer, feminist, activist, and United States Congresswoman, who for many decades championed women's rights [1], said that she had a mother who thought she "could do no wrong". She also had a husband who supported all her activities, and a network of friends who liked her ideas. She rose to prominence very quickly and, for a woman born in 1920, this was indeed an usual achievement. However, we know from research over recent decades that, in general, girls have been socialized and educated in ways different from boys, with a tendency towards compliance (dependency) for girls and exploration (independence) for boys.

It is not difficult to see that personal support and approval may have substantial implications for expression of independent scholarship and leadership later in life. Incidentally, the small cohort of women who have been awarded Nobel prizes, have won these in the United States, not because the recipients were all American (indeed, their ethnic and national backgrounds have been quite diverse) but, in all likelihood,

because some key conditions for excellence in scientific research are more often met in the United States than in other countries. Although women in academia have to fight no less than elsewhere, among those key conditions may well be general high approval ratings, and money to follow, for those who have been identified as high flyers.

Leadership thrives naturally in the context of high approval rating, which in turn, engenders self-esteem and a feeling that the world is open for one's taking. Leadership may wither in victim mentality, victimized and traumatized lives, marginalization, and violent or indifferent contexts. Rescue operations of the gifted from any of those negative environments are often long and arduous. Those who survive extraordinarily demeaning experiences and still come out on the other side tend to be immensely strong individuals. However, one must not assume that leadership and high levels of scholarship require a dose of demeaning experiences. Clearly, social attitudes about an alleged inability of women to be professional and have scientific minds, as well as strong moral sanctions against women stepping into public life, give plenty of grounds to explain women's absence from public life for so long.

Most science claims to be value-free but the term "biopolitics" is not of recent origin [21]. It suggests an interdependence between beliefs and scientific findings, as if research is seeking confirmation for certain values and beliefs by the predetermined way in which questions are asked. In the life sciences in particular, social beliefs are deeply intertwined with professional and research practices in the field. In fact, perhaps in no other sciences are personal values and social attitudes more visible [3,20,21]. Female scientists too have to examine their own motivations and beliefs because their socialization has also exposed them to the dominant norms and values about science (not just gender roles), and these might have been absorbed in subtle ways (confusing genetic explanations with femininity/masculinity scores that are not actually bound by biological sex). Perhaps the most biased recent example of biopolitics can be found in the writings of evolutionary psychologists who make very clear pronouncements about human nature, divided into clear gender roles, which allegedly were formed in the Stone Age. According to evolutionary psychology, we are said to have stone-age brains that are genetically hard-wired to make men and women different in

fundamental (behavioral) ways [23]. These arguments are meant to create doubt about the supposedly equal abilities of men and women, and such arguments could potentially also be used by policy makers to reinstate old gender discrimination rules (see also Rogers in this volume). These are forces in the public domain that have to be recognized as social forces with vested interests, and not as factual reporting of science [24]. Most importantly, however, is it for women to be aware that there are restrictive forces that might require identification to better cope with and overcome them, so that it will be fruitful and possible to remain focused on one's own ideas and projects.

FREEDOM TO EXPLORE

Is to stand alone a matter of leadership or is it one of fortitude and strength? Past examples certainly show us women who have had extraordinary success—eventually—by following their own vision and ideas, often against all odds. Science becomes exciting when it is used to discover the unknown world. To conceive of what has not been, to make connections that have not been made before, and to discover new principles invariably requires some flights of fancy, quiet thinking time, and perhaps even a kind of obsession. Here, instead of a well-laid out plan of action, what is needed is adaptability, flexibility and a certain degree of non-conformity. It is more important to plan experiments around important ideas and do so with the greatest circumspection than to occupy one's mind with the trappings of planning a career (see details later).

The scientific life of Barbara McClintock might serve as a prime example of the capacity to follow one's own mind against the odds [25]. She won the Nobel Prize for Physiology and Medicine in 1983 for her visionary work showing genetic transposition, which refers to her discovery that genetic elements can move from one site on a chromosome to another, and even dissociate from one chromosome to be inserted in another. This introduced an entirely new conception of the genome as dynamic, rather than being a static linear message, and it placed more emphasis on environmental influences (both internal and external to the cell) than the central dogma allowed. She worked on the cytogenetics of maize. Using techniques of analysis that were at the time considered to

be unfashionable, in the 1950s and 1960s, she swam against the current of the new molecular genetics, even while no one listened to her. In an interview on film she thanked the chairman of her department for allowing her to continue researching without interference. She worked in virtual isolation and, as she says, people thought she was doing odd things that were of no particular interest, but they allowed her to continue.

Keller points out that McClintock's life is not merely "a tale of dedication and reward after years of neglect—of prejudice or indifference eventually routed by courage and truth.... It is a story about the nature of scientific knowledge, and of the tangled web of individual and group dynamics that define its growth" [25]. It is one thing to have a groundbreaking idea, another to have the wherewithal to follow it through in research, and yet another to make sure the idea and the research are recognized and find their way into the body of scientific knowledge. To practice science successfully at the level of discovery demands the interplay of (1) an individual following a highly personal train of ideas; and (2) a worker within the community of scientists. Obtaining funding for the research and a salary on which to live are set firmly within the domain of the community of scientists. Finding time for research depends on an interaction between (1) and (2) and, of course, having original ideas is almost entirely based on point (1). McClintock was extraordinarily successful at the latter but she had great difficulty in obtaining any continuous funding, particularly a salary.

In fact, there is an uneasy balance between individuality and group acceptance in scientific research and a female scientist almost certainly balances on a much sharper edge than does her male counterpart. On the one hand, women are taught to conform in a male-dominated world and, since the scientific community is still largely male-dominated, apart from an increasing number of exceptions, female scientists tend to take up and work with the ideas of male scientists rather than striking out on their own. However, if women express dissent and arrive at new ideas, they may well face a harder battle to gain acceptance of their ideas than do men in the same situation, let alone be rewarded for them. Women are generally afforded far less opportunity to be free to follow their own ideas and, when they do, they are often ridiculed. Even today, women's ideas often do not achieve the same visibility and are not being cited as often as those

of their male peers [22]. McClintock experienced this situation.

McClintock's life may not be an example for female scientists in general. In fact, she herself thought that she was too different and too much of a maverick to impart anything of direct value to other female scientists. Nevertheless, her life in research reveals many of the forces that interplay in the life of a female scientist. From it might come some wisdom for at least some of us. Of course, few if any of us, women or men, could follow her to the heights of her achievements, but there might be something essential that pertains to a broad spectrum of female scientists.

To us, with our modern lifestyles, her advice to "take time and look" has deep resonance. There must be uninterrupted time to become absorbed in seeking answers. McClintock remembers being so absorbed that she would forget even her own name. When she looked at a cell under the microscope, she said that she would "get down in that cell and look around", and "when I was really working with them I wasn't outside, I was down there. I was part of the system." [25].

MENTORING AND NETWORKING

The literature on mentoring and networking continues to thrive. In some cases, it has promoted a view of a more assertive (or aggressive) self-advertisement to overcome whatever the perceived hurdles might be. One of the well-known and more recent crop of self-help books for women called *Be your own Mentor* [26], basically confesses that mentoring for women does not work well or in the same way as for men. The authors have promoted a strategic model of managing one's own career from start to finish by a number of very specific behaviors. The authors recommend impressing managers, managing time well, and to "blow your own trumpet", as well as to show your expertise, make strategic plans, get on committees, and diversify your interests and networks. In this model, everything is planned and strategically pre-conceived. This might or might not be good advice for someone who wants to go into business or public service. However, for a life in research, most of these points (except for time management) are irrelevant, disastrous or even counterproductive.

Mentoring studies have been around for a long time, and many of these are within education and at

any level of education (primary, high school, university [27], vocational and professional training, and special needs/interest groups including women) [28,29]. How successful are mentoring programs and what has been found? This might be quite contradictory, often because of the lack of an overarching theory [30] and the contradictory nature of mentoring itself, that is, those who are mentored might not be the ones that benefit most, and those who should benefit are not always the target [31]. There have also been changes over time. Once mentoring was called a patron system, which indicated a mentor of considerable power who made it his (usually not her) business to promote his apprentice in return for obedience and unquestioned service [32]. The trend today is towards a more democratic model and the goal of empowering individuals to feel more confident in what they do.

There is some consensus that mentoring ought to be for a positive purpose and outcome for the mentee rather than the mentor. Within my own life, I have found that this is not always correct. Some false mentors seek to help to further their own careers, by familiarizing themselves with other people's projects and ideas, skills, and writing (that one then finds published without one's own name on it, or grants submitted based squarely on one's own project; or a promotion application made on the basis of a project to which they have contributed nothing), or avail themselves of free labor without any intention of offering anything in return. These things still happen, not too often, but relatively regularly. Caution is thus indicated to whom one entrusts oneself with one's ideas, skills and written projects. In other words, the assumption that mentoring is beneficial to the person being mentored [33], demands a minimal standard of ethical values from the mentor [34] and, when mentoring a woman, a non-sexist attitude [35]. It is therefore wise not to rush for advice and help to any senior/experienced member of staff or group unless that person is known to be fair and benevolent [31]. You should have evidence that this person has your interest at heart.

Mentoring has become quite a formalized matter in many organizations and institutions and, in some regards, it has even been nationally prioritized as an area of great importance for training, staff retention [36], staff development, better team work, and raising performance standards generally [37]. Thus mentoring is seen as at least offering assistance in professional development, providing a role model and, most likely,

also boosting the confidence of the person receiving the mentoring. At a personal level, however, some of these formal arrangements often do not work, either because the mentee is too eager and increasingly takes more time from the mentor than the mentor can give, the mentor is only half-heartedly advising and leaves the individual even more confused than before the process began, or the two people simply do not like each other. Regardless of some of the failures in mentoring when conceived of too narrowly or inflexibly, there is good evidence that environments that are supportive of the enthusiasm of staff and are ready to guide this in constructive ways, will make people thrive and develop and remain in the institution in which this is made possible.

CONCLUSION

There has been relatively little research on networking among women, let alone in science, but it is suspected that women get far less exposure to mentoring than men, be this in professions or in research. In my own career, I have been fortunate enough to have always had close friends in my field who were happy to read my draft papers or give advice. At a personal level, such mentoring has been hugely important and I am tremendously grateful for this. I am certain that it has made a difference both personally and in the performance of my work (e.g. in publishing) that such benevolent and invariably useful advice was at hand. To this day, I rely on friends rather than on formal structures and I, in turn, support as many students and young colleagues as is possible, again, on a very personal level.

Institutions can do a great deal to foster such relationships and careers by providing opportunities (research culture) that are supportive rather than competitive, install no ceilings (glass, real or otherwise), allow people to develop ideas, and be supportive of them (have support staff and provide money and time). Gertrude Elion, in her acceptance speech of the Nobel Prize in 1988 quoted Sir Henry Wellcome, founder of the Wellcome Laboratories, as saying: "If you have an idea, I will give you the freedom to develop it". She said that this "philosophy supported us through four decades of research and continues to nurture our successors." In other words, my advice is, apart from hard work and conscientiousness, to retain curiosity and creativity and, most of all, a passion for

what you do. Presumably, to lead such a life, you would need to believe in yourself, set your own standards (preferably higher than demanded), be self-critical, focus on your interests and what inspires you, and create quiet thinking places for yourself, and then surround yourself with a handful of friends and people whom you can trust and with whom you are comfortable to work. Those variables do not require so much management as focus, not so much strategic planning as content, and not so much career thinking as thinking of the substance of your work.

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